Before the
Federal Communications Commission
Washington, D.C. 20554

In the matter of	)	
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ORBITAL COMMUNICATIONS CORPORATION	)	
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	)	
For Modification of Its Authorization to Construct, Launch and Operate a Non-Voice, Non-Geostationary Mobile-Satellite System in the 137-138 and 148-150.05 MHz Frequency Bands	)	File No. SAT-MOD-19990318-00029
	)	File No. SAT-AMD-19990927-00092
	)	File No. SAT-AMD-20000120-00001

ORDER AND AUTHORIZATION

Adopted: April 8, 2002 **Released:** April 9, 2002

By the Chief, International Bureau:

I. INTRODUCTION

1. With this Order, we authorize Orbital Communications Corporation ("Orbcomm") to modify its low-Earth orbit non-voice, non-geostationary mobile-satellite service system ("Little LEO" system) by decreasing the number of satellites in its two highly-inclined orbital planes, operating the fourth plane of satellites at 45° inclination, and increasing the altitude of the satellites in the equatorial plane of its system under certain conditions. This modified authority will allow Orbcomm to meet its customer requirements without increasing the potential for interference to other Little LEO systems.

II. BACKGROUND

2. The International Bureau granted a system license to Orbcomm in 1994 as part of the first processing round of Little LEO applications.[1] In 1998, as part of the second processing round ("Second Round"), the Bureau modified Orbcomm's system license to expand its constellation to 48 satellites, consisting of four orbital planes at 45° inclination, a fifth plane at 70° inclination, and a sixth plane at 108° inclination, with eight satellites orbiting in each of the six planes.[2]

3. Soon after it received its Second Round license, Orbcomm requested authority to substitute one of the four orbital planes at 45° inclination for an equatorial plane (a plane at zero degree inclination). Orbcomm stated that the equatorial plane would allow it to reduce outage times in areas below 50 degrees latitude while maintaining approximately the same degree of near-continuous coverage authorized in its

[1] *Orbital Communications Corp.*, Order and Authorization, 9 FCC Rcd. 6476 (1994) ("*First Round Orbcomm License*"), *recon. denied*, 10 FCC Rcd. 7801 (1995).

[2] *Orbital Communications Corp.*, Order and Authorization, 13 FCC Rcd. 10828 (1998) ("*Orbcomm License*").

license for other areas.[3] It sought to operate the equatorial plane at 825 kilometers, the altitude authorized for the other satellites in its systems.[4] The Satellite and Radiocommunication Division granted this unopposed application on July 17, 1998.

4. Orbcomm then filed this modification application on March 18, 1999 ("March 1999 Modification Application").[5] In this request, Orbcomm seeks authority to reduce the number of satellites in the equatorial plane from eight to seven, and to increase the altitude of that plane from 825 kilometers above the Earth's surface to 1000 kilometers. Two Little LEO licensees, Leo One Worldwide ("Leo One") and Final Analysis Communications Services ("Final Analysis"), filed comments on this application.[6] Orbcomm amended the March 1999 Modification Application in September 1999 ("September 1999 Amendment"), requesting authority to implement a fourth inclined plane (at 45° inclination) of eight satellites, and to reduce the number of satellites in the 70º and 108º high inclination planes from eight to four satellites each.[7] Orbcomm noted that there would be no increase in the number of satellites in orbit, but that the satellites would be redistributed toward the lower inclination orbital planes. Orbcomm amended the March 1999 Modification Application a second time in February 2000 ("February 2000 Amendment") to respond to objections from Leo One and Final Analysis regarding the altitude of the satellites in the equatorial plane. In the February 2000 Amendment, Orbcomm revised the requested altitude to 975 kilometers. Leo One then withdrew its opposing comments.[8]

5. In October 1999, Orbcomm requested authority to launch the satellites in its proposed fourth 45° inclination plane in order to meet a launch scheduled for December 1999.[9] The Satellite and Radiocommunication Division granted this unopposed application because it did not change the overall spectrum utilization characteristics established in Orbcomm's second round license as modified in July 1998.[10] After it launched this plane of satellites, Orbcomm requested special temporary authority to operate the satellites because no other Little LEO licensees were scheduled to become operational during

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[3] Orbital Communications Corporation Modification Application, File No. 109-SAT-ML-98 (filed April 15, 1998).

[4] *Id.* at Technical Attachment p. 3.

[5] Orbital Communications Corporation Modification Application, File No. SAT-MOD-19990318-00029 (filed March 18, 1999).

[6] Final Analysis Communication Services, Inc., Comments (filed May 27, 1999); Leo One Worldwide, Inc., Comments (filed May 27, 1999).

[7] Orbital Communications Corporation Amendment to Modification Application, File No. SAT-AMD-19990927-00092 (filed September 27, 1999).

[8] Letter from Robert A. Mazer, counsel to Leo One Worldwide, Inc., to Magalie R. Salas, Secretary, Federal Communications Commission (June 6, 2000). *See also* Letter from Aileen A. Pisciotta, Counsel for Final Analysis Communication Services, Inc. and Stephen L. Goodman, Counsel for Orbital Communications Corporation, to Donald Abelson, Chief, International Bureau (March 3, 2000) which says that "[a]ssuming acceptance by the Commission of Final Analysis's proposals on the record, and without prejudice to Orbcomm's right to maintain its position under Section 25.142(a)(1), to the extent that the parties have objected to the proposed constellation modifications of the other, those objections are hereby withdrawn." While the Commission encourages applicants to settle their differences, it is not clear whether Final Analysis's conditional withdrawal was ever effected. Consequently, we continue to consider Final Analysis's comments in acting upon Orbcomm's application.

[9] Orbital Communications Corporation Modification Application, File No. SAT-MOD-19991021-00099 (filed October 21, 1999).

[10] *Orbital Communications Corp.,* Order and Authorization, 15 FCC Rcd. 1340 (Satellite and Radiocommunciation Div., rel. December 2, 1999).

the six months of authority requested.[11] The Division granted special temporary authority, but conditioned it on Orbcomm ceasing operations over the fourth 45°-inclination plane if and when another Little LEO licensee commenced commercial operations.[12]

III. DISCUSSION

6. Orbcomm's March 1999 Modification Application, as amended, requests authority to make four changes to four of the seven planes that make up Orbcomm's Little LEO system. First, Orbcomm seeks to reduce the number of satellites in its equatorial plane, from eight to seven satellites. Second, it seeks to increase the altitude of the equatorial plane from 825 to 975 kilometers. Third, Orbcomm asks for unconditional authority to operate a fourth plane at 45° inclination.[13] Fourth, Orbcomm proposes to cut in half the number of satellites in each of its two highly inclined planes at 70° and 108°, from eight to four.

7. Orbcomm shares its uplink spectrum in the 148.0-149.9 MHz frequency band with Leo One, Final Analysis, and E-SAT, Inc.[14] Final Analysis asserts that there is a significant uncertainty as to the appropriate measure of potential interference among NVNG MSS licensees in dynamically shared uplink frequencies, so the Commission must establish an interference standard before it acts upon the Orbcomm application.[15] In the downlink direction, Orbcomm shares its spectrum in the 137.0-138.0 MHz frequency band with E-SAT.[16] Final Analysis, which does not share downlink spectrum with Orbcomm, nevertheless argues that we should deny Orbcomm's proposed change in altitude. Final Analysis argues that Orbcomm has not provided sufficient information to support a finding that its requested increase in altitude for the equatorial plane will not cause interference to other Little LEO systems operating in the shared downlink band.[17] Final Analysis also argues that Orbcomm's out-of-band emissions in its downlinks at a higher altitude could affect Final Analysis's system.[18] Final Analysis also notes that its constellation is licensed at an altitude of 1000 kilometers, and fears that Orbcomm satellites operating at the same altitude, as Orbcomm initially proposed, would crowd its constellation.[19] Final Analysis did not, however, comment on Orbcomm's revised proposal to operate the equatorial plane at 975 kilometers.

8. As an initial matter, we will not prescribe an appropriate measure of potential interference for the Little LEO licensees, as Final Analysis requests. As the Commission noted in a decision on Final Analysis's system, such a measure is necessarily based upon a set of subjective assumptions about worst-case scenarios.[20] The spectrum available for Second Round Little LEO systems could not accommodate

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[11] Orbital Communications Corporation, Request for Special Temporary Authority, File No. SAT-STA-20000202-00055 (filed February 2, 2000).

[12] Letter from Thomas S. Tycz, Chief, Satellite and Radiocommunication Division, to Paul Locke, Senior Director, Systems Engineering and Spectrum Management, Orbital Communications Corporation (May 16, 2000) ("*Orbcomm STA*"). This authority was extended by grant-stamp on January 9, 2001, and again on November 28, 2001. This special temporary authority will expire on May 28, 2002.

[13] Orbcomm was granted special temporary authority to operate this fourth plane in 2000. *Orbcomm STA*.

[14] *Orbcomm License*, 13 FCC Rcd at 10834.

[15] Final Analysis Comments at 6; Final Analysis, Reply to Opposition of Orbcomm, at 2 (filed June 17, 1999).

[16] *Orbcomm License*, 13 FCC Rcd at 10836.

[17] Final Analysis Comments at 2.

[18] *Id.* at 4.

[19] *Id.* at 6.

[20] *Final Analysis Communications Services, Inc.*, 16 FCC Rcd. 21463, 21474 at ¶ 35 (2001).

all proposed systems. To resolve a potential mutually exclusive situation, the five applicants presented the Commission with a frequency sharing agreement that they asserted would accommodate them all. The agreement required Little LEO systems to share the identified spectrum, including the uplink frequencies whose use is in dispute here.[21] The Commission relied upon the applicants' Joint Proposal, and the assumptions about acceptable interference inherent in the Joint Proposal, in adopting its Second Round *Report and Order* and the five individual second round licenses.[22] If the applicants had not agreed to a plan that accommodated them all, the Commission would have adopted another selection mechanism to choose among the mutually exclusive applications. As before, we are not in a position to dictate an appropriate measure of potential interference among the Little LEO licensees sharing uplink spectrum.

9. With respect to Orbcomm's specific modification requests, we note that we have authorized several modifications to Orbcomm's system subsequent to the issuance of the second round licenses, including a request to substitute the equatorial plane for one authorized plane at a 45º inclination. We approved these requests because none of the Little LEO licensees sharing the affected frequency bands objected to the proposed changes. To the contrary, where another Little LEO licensee objects to a proposed change, we compare the applicant's proposed system with its second round license to determine whether the modification increases the potential for interference with co-frequency Little LEO systems. We now evaluate each of Orbcomm's proposed modifications in that manner.

10. Orbcomm first proposes to decrease the number of satellites in its two highly inclined planes, from eight to four. No other Little LEO licensee opposes this modification. Further, fewer in-orbit satellites in these planes will result in a decrease in potential interference to any other Little LEO systems. We therefore grant this request.

11. Second, to maintain the number of satellites licensed to its constellation in the second round, Orbcomm proposes to shift the eight satellites taken from its two highly inclined planes to re-create a fourth plane at 45° inclination. No other Little LEO licensee opposes this request. Further, the proposed modification returns Orbcomm's system to the number of 45° inclination planes initially authorized in its second round license. Accordingly, we grant Orbcomm's request for regular authority to operate four planes at 45° inclination.

12. Orbcomm's final two proposed changes relate to its equatorial plane. Orbcomm seeks to increase the altitude of the plane from 825 kilometers to 975 kilometers, and to reduce the number of satellites in the plane from eight to seven. Because we find that a reduced number of satellites in a plane results in a decrease in potential interference, we grant the request to reduce the number of satellites in the equatorial plane. The proposed increase in altitude raises concerns regarding orbital debris, however, and it has the potential to increase electrical interference to other Little LEO systems. We address the orbital debris issues first.

13. The Commission has addressed issues regarding orbital debris and satellite systems on a case-by-case basis.[23] Such concerns regarding Orbcomm's Little LEO system have been addressed twice previously. In 1997, Orbcomm proposed an increase in altitude of its constellation to avoid potential

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[21] Joint Proposal of E-SAT, Inc., Final Analysis Communication Services, Inc., Leo One USA Corporation, Orbital Communications Corporation, and Volunteers in Technical Assistance (filed Sept. 22, 1997) ("*Joint Proposal*").

[22] *Amendment of Part 25 of the Commission's Rules to Establish Rules and Policies Pertaining to the Second Processing Round of the Non-Voice, Non-Geostationary Mobile Satellite Service*, Report and Order, FCC 97-370, 13 FCC Rcd 9111 (1997) ("*Report and Order"*).

[23] *See Mitigation of Orbital Debris*, Notice of Proposed Rulemaking, FCC 02-80 (released March 18, 2002) ("*Mitigation of Orbital Debris Notice*") at ¶ 16.

collision between its satellites and those in the Iridium constellation.[24] In 1997, the Commission sought, and in 1998 received, advice from the National Aeronautics and Space Administration ("NASA") on orbital debris issues relating to Orbcomm's satellite constellation, particularly the orbital lifetime of its satellites.[25]

14. Both the Commission's request and NASA's response focused on an optimal post-mission lifetime for LEO systems of 25 years.[26] U.S. Government Standard Practices recommend that LEO system operators dispose of their spacecraft at the end of their mission lifetime through atmospheric reentry.[27] For LEO systems, this may be accomplished either by using the spacecraft's propulsion system to propel the spacecraft out of orbit and into the Earth's atmosphere, or by leaving the spacecraft in an orbit in which it will remain for no longer than 25 years after mission completion.[28] NASA advised the Commission that Orbcomm's satellites at 825 kilometers would have a post-mission lifetime greater than 25 years, but that their "slightly longer-than-desired projected orbital lifetime might be viewed as an acceptable variance for an established system."[29]

15. Because Orbcomm's proposed increase in altitude for satellites in the equatorial plane from 825 to 975 kilometers is likely to increase substantially their orbital lifetime, we cannot conclude on the record before us today that this increased altitude would be consistent with the public interest, unless steps are taken to reduce the orbital lifetime of those satellites. Consequently, if Orbcomm wishes to implement this change in altitude, we will require it to adopt measures to address the orbital lifetime of satellites in its proposed equatorial plane through a revised propulsion system, or through other measures to reduce their orbital lifetime.[30] If Orbcomm chooses not to or is unable to meet this condition, it will be required to deploy the satellites in the equatorial plane at an altitude of 825 kilometers.

16. Further, we note that in Final Analysis' comments on Orbcomm's modification, it claims that the change in altitude will cause a potential increase in usage of shared uplink bands.[31] This is because the higher altitude will expand the "footprint" or coverage area of the satellites into Hawaii and the extreme southern reaches of the continental United States. The expansion of Orbcomm's potential customer base into parts of the United States not previously covered by the equatorial plane will affect potential usage by the other Little LEO systems in these areas because a limited number of users can operate in the shared uplink frequencies. Consequently, an increase in the number of customers using the Orbcomm system at any one time will decrease the number of available channels for other Little LEO systems. We consider Final Analysis's comments an objection to Orbcomm's proposed change in altitude, on the basis that it will cause a potential increase in usage of shared uplink bands. We find that

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[24] *See* Orbital Communications Corporation application to modify its non-voice, non-geostationary satellite service license, File No. 194-SAT-ML-97 (filed Sept. 26, 1997), Technical Appendix.

[25] *See* Letter dated December 31, 1997 from William Kennard, Chairman, FCC, to Daniel S. Goldin, Administrator, NASA; Letter dated February 11, 1998 from Daniel S. Goldin, Administrator, NASA, to William Kennard, Chairman, FCC; Letter dated March 4, 1998 from Nicholas L. Johnson, NASA Chief Scientist for Orbital Debris, to Karl Kensinger, FCC International Bureau (the "*NASA Orbcomm Letter*").

[26] *NASA Orbcomm Letter* at 2.

[27] *See Mitigation of Orbital Debris Notice* at ¶¶ 52, 56.

[28] The altitude from which a spacecraft would reenter the Earth's atmosphere in 25 years is roughly 600 kilometers, depending on the characteristics of the spacecraft and variations in atmospheric drag due to solar activity. *Mitigation of Orbital Debris Notice* at ¶ 56.

[29] NASA Orbcomm letter at 3.

[30] *See Mitigation of Orbital Debris Notice* at ¶¶ 52-53.

[31] *See* ¶ 7, *supra*.

an increase in altitude of the equatorial plane has the potential to increase interference to other Little LEO systems sharing uplink frequency bands in Hawaii and the extreme southern reaches of the continental United States.[32] Because of this increase in potential interference to other Little LEO systems, we will not permit Orbcomm to serve the United States from the equatorial plane at the higher altitude in the absence of agreement among all potentially affected Little LEO licensees.

17. Nevertheless, we recognize that Orbcomm may wish to provide international service from its system. We will not condition international operations on agreement among all potentially affected Little LEO licensees. While the change in altitude of Orbcomm's equatorial plane also has the potential to affect its coordination with other Little LEO systems in areas outside the United States, we believe it is premature to attempt to resolve international sharing difficulties between U.S.-licensed Little LEO systems before they arise.[33] We will, instead, retain our flexibility to implement coordination methods that are most appropriate to the given set of circumstances that might arise from co-frequency Commission licensees operating outside the United States.

IV. CONCLUSION

18. We allow Orbcomm to reduce the number of satellites in its equatorial plane, from eight to seven satellites. We also allow Orbcomm to increase the altitude of that equatorial plane from 825 to 975 kilometers subject to Orbcomm developing debris mitigation measures. We also condition Orbcomm's operation of its equatorial plane by prohibiting service to the United States from that plane at the higher altitude absent agreement from all potentially affected Little LEO licensees sharing uplink frequency bands with Orbcomm. We allow Orbcomm permanent authority to operate its fourth plane of satellites at 45º inclination, and we allow Orbcomm to cut in half the number of satellites in each of its two highly inclined planes at 70° inclination and 108° inclination, from eight to four.

V. ORDERING CLAUSES

19. Accordingly, IT IS ORDERED, subject to the conditions set forth in this Order and Authorization, that Application File No. SAT-MOD-19990318-00029 for modification of Orbital Communications Corporation's non-voice, non-geostationary mobile-satellite system, as amended, File No. SAT-AMD-19990927-00092 and File No. SAT-AMD-20000120-00001, IS GRANTED in accordance with the technical specifications set forth in the application, consistent with the Commission's rules, and as conditioned by this Order.

20. IT IS FURTHER ORDERED that Orbital Communications Corporation IS AUTHORIZED to operate its equatorial plane of satellites at an altitude of 975 kilometers on the condition that Orbital Communications Corporation either lowers the satellites in the equatorial plane at the end of their operating lifetime to an orbit from which they can be reasonably expected to re-enter the Earth's atmosphere within 25 years, , or through other measures to reduce their orbital lifetime. IT IS FURTHER ORDERED that Orbital Communications Corporation may not serve the United States from satellites operating in the equatorial plane at an altitude of 975 kilometers absent agreement from all potentially affected Little LEO licensees sharing its uplink frequency bands.

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[32] We calculate this potential reach of Orbcomm's space stations from the equatorial plane using basic principles of orbital mechanics, including satellite range and angle of elevation. Taking a space station in Orbcomm's constellation at the proposed equatorial plane altitude of 975 kilometers, and an Earth station with an elevation angle of five degrees, the space station has the potential to communicate as far north as 25.2 degrees latitude.

[33] *First Round Orbcomm License*, 9 FCC Rcd at 6478.

21. If Orbital Communications Corporation cannot meet the debris mitigation measures condition in Paragraph 20 of this Order and Authorization, IT IS FURTHER ORDERED that the authorized initial altitude of the equatorial plane shall remain 825 kilometers. Orbital Communications Corporation may serve the United States from satellites operating in the equatorial plane at this altitude.

22. IT IS FURTHER ORDERED that in the event Orbital Communications Corporation chooses to launch satellites in its equatorial plane to an altitude of 975 kilometers, it shall submit an application for modification of its authorization to include authority for an end-of-life disposal, at least 180 days prior to launch of any satellite in its equatorial plane.

23. IT IS FURTHER ORDERED that Orbital Communications Corporation will prepare the necessary submissions to the International Telecommunication Union (ITU) and to affected administrations for the completion of the appropriate advance publication, coordination, and notification obligations for these space stations and their modifications in accordance with the ITU Radio Regulations. No protection from interference caused by radio stations authorized by other Administrations is guaranteed unless coordination procedures are timely completed or, with respect to individual Administrations, by successfully completing coordination agreements. Any radio station authorization for which coordination has not been completed may be subject to additional terms and conditions as required to effect coordination of the frequency assignments of other Administrations, 47 C.F.R. § 25.111(b).

24. IT IS FURTHER ORDERED that Orbital Communications Corporation is afforded thirty days from the release of this Order and Authorization to decline this authorization. Failure to respond within that period will constitute formal acceptance of the authorization.

25. IT IS FURTHER ORDERED that this Order and Authorization is issued pursuant to Section 0.261 of the Commission's Rules, 47 C.F.R. § 0.261. Petitions for reconsideration under Section 1.106, or applications for review under Section 1.115 of the Commission's Rules, 47 C.F.R. §§ 1.106 and 1.115, may be filed within 30 days of the date of public notice of this Order and Authorization (see 47 C.F.R. § 1.4(b)(2)).

FEDERAL COMMUNICATIONS COMMISSION

Donald Abelson
Chief, International Bureau